DOCUMENT RESUME

ED 188 008 CE 025 816

TITLE	Ecology and Energy Action Pack.
INSTITUTION	Dayton Museum of Natural History, Ohio.; McDonald's Corp., Oak Brook, Ill.
PUB DATE	77
NOTE	36p.; For related documents see CE 025 302 and CE 025 817-819.
AVAILABLE FROM	Mazer Corp., 2501 Neff Rd., Dayton, OH 45414 ($3.00)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Conservation (Environment); *Ecology; Elementary Education; *Energy; *Environmental Education; Instructional Materials; Learning Activities; *Natural Resources; Recycling; Waste Disposal; Water Pollution

ABSTRACT

One of five McDonald's Action Packs, these elementary school-level instructional materials are for use as an introduction to existing units of study, supplements to a textbook, or a source of special projects for environmental education. Contents include these six units: Make Your Own Ecology Mini-spinner, Let's Look at a Food Chain, Drip the Water Drop and Save Me, A Very Short History of Trash and How Paper Is Recycled, Be an Ecology Champion, and Buzzy Bee's Easy Guide to Energy. Each unit may include some or all of the following: background ideas that discuss purpose of the following activity, discussion of the activity, suggestions for use of the student activity sheets, and additional activities. Reference is made within the units to activity sheets provided at the back, which are suitable for reproduction. A copy of a transparency recommended for use in one unit is also provided. (YLB)

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Ecology and Energy

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Introduction

Dear Colleague:

As a teacher you know the importance of environmental quality.

And as a teacher you are able to influence attitudes of today's students that can improve tomorrow's world.

These student attitudes, presently reflected at home, school and playground will one day influence manufacturing, business and politics. The degree to which you can create an understanding of the relationship of people to the natural world will help determine how long people will be a part of that world.

The topics in the *McDonald's Ecology and Energy Action Pack* have been developed so that you, as a busy teacher, can use them to make the job of teaching environmental awareness a little easier. The materials in this book may be used to introduce existing units of study, may serve as high-interest supplements to a textbook, or as a source of special projects. However they are used, the materials are intended to stimulate thinking and activity that will carry beyond the school. That McDonald's has elected to be the vital link between our creative efforts and your classroom is evidence of the great importance that environmental education has for those outside the educational system.

We believe that students can have an immediate and catalytic influence on parents, teachers, neighbors and business people. Our own museum program, covering all aspects of the natural sciences, has for many years given us confidence in the impact of young people who become interested in their complex world. They *can* learn to live in it happily without spoiling it for those who follow. They *do* influence their elders and carry their training into adulthood.

It is with the hope for such a ground swell of concern and understanding that we prepared this material for McDonald's. Along with McDonald's we hope that you will find the *Ecology and Energy Action Pack* a practical and useful resource in the months ahead.

Sincerely,

E. J. Koestner

E. J. Koestner, Director

Dayton Museum of Natural History
Dayton, Ohio

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The *Ecology and Energy Action Pack* was developed by the staff of the Dayton Museum of Natural History under the direction of E. J. Koestner, Museum Director. Museum staff members contributing to the materials were Dorothy Morse, Roger Hoefer, Jennifer Agnew, Robert Lyons and Mary I. Stover.

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The master can be stored for later use by removing it from the spirit duplicator and placing it back in its original place between the tissues of this book.

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Unit 1-Make an ecology mini-spinner

Activity Masters 1 and 2

Background Ideas

"We need fewer Ecology posters and more ecology action!"

That's what one teacher said when the Mini-Spinner was described to her.

Ten days later, her students were busily making classroom displays based on the Mini-Spinner design. And the teacher? She was bustling from group to group, just as enthusiastic as her students were about the project.

Why the change in point of view?

She had discovered what we hope you will find: that the Mini-Spinner offers more for students than time-consuming busy work.

The Mini-Spinner's purpose is threefold:

To provide a basis for student discussion of the six ecology slogans on the Mini-Spinner panels (see two spirit masters that follow).

To provide students with a model to construct large poster displays.

To provide students with an opportunity to work together to create their own slogans and artwork.

Before discussing the meaning of the six slogans, ask students what ecology is. Most people recognize the word, but few know what it means.

Ecology comes from the Greek *ekalogie*—the study of homes or estates. Today, ecology is still the study of homes—our home, the earth. When we study ecology we study how living things interrelate with each other and with their environment. Recently we have focused on that part of ecology which emphasizes human impact on the earth's natural systems. Ecology doesn't view people as outsiders to these systems; rather it sees people as part of nature and subject to its laws.

The Mini-Spinner's slogans emphasize that people are part of nature, that they must recognize the influence of their actions on nature's systems. From the study of ecology we learn that people are obligated to act with forethought in anything they do that affects nature.

Discussion

Slogan 1. "You can serve your world if you conserve energy."

Recent shortages have dramatized the energy problem in the United States. At our present rate of use, our gas and oil reserves will last only 50-60 more years. What is worse, we use almost double the amount of petroleum that we produce. This not only makes us increasingly dependent upon other countries, but is a drain on the world's energy supply (the U.S., which has only 6% of the world's people, accounts for more than 33% of its energy use.)

One answer to this shortage is to develop new types of energy. However, since that will take time, the only answer in the short run is that we must learn to conserve. If we use only as much energy as we need, always thinking of ways to conserve, each of us can help to ease the energy crisis.

Slogan 2. "Point your finger at a polluter and you'll have three fingers pointing back at you!"

The message in this slogan? Ask your students to think about it. The answer, of course, is that each of us contributes to pollution.

To control pollution then, all of us must do our part. It isn't enough to point a finger at others and think that we are innocent. We can't easily condemn power plants or strip mines while we thoughtlessly toss bottles and cans along the highway.

Slogan 3. "All of Us Can Be Ecologists."

While, in the strictest sense of the word, an ecologist is one who is professionally involved in the field of ecology, all of us who are actively concerned (that is, all of us who care about maintaining a healthy relationship between people and the rest of nature *and are doing something about it*) are ecologists.

Interest alone does not make one an ecologist, but anyone who is interested enough to recycle trash, conserve water or (as an adult) work on a citizens' committee to protect the environment has earned the title.

Slogan 4. "Put litter in its place!"

Litter is solid waste without a home. It has damaging ecological and aesthetic consequences. Consider this example: a survey has shown that there is an average of 1304 pieces of litter per square mile in our country.

Each piece of litter represents not only a problem for the environment, but a missed opportunity—someone has failed to act responsibly.

Slogan 5. "Recycling saves resources."

Many of our raw materials are in short supply. It makes sense, then, to recycle as much trash as possible—to reuse the materials out of which they were made. Recycling

- reduces the volume of trash to be buried or burned
- reduces damage to the environment that frequently comes with extraction (mining drilling) of raw materials
- reduces the drain on our raw materials.

Slogan 6. "A flower seed is a great investment. Plant one and see the returns."

Flowers and plants offer valuable benefits to the environment. They

- make an important aesthetic contribution
- absorb carbon dioxide from the air and release oxygen for man and animals
- prevent erosion by gripping the soil with their roots.

Planting flowers may not head the list of environmental priorities, but it can be a valuable educational activity. In flowers, students can see the rewards of planting seeds. Flowers can also provide the basis for a discussion of how natural systems operate.

How to use the activity masters

1. Ask students to discuss the slogans on the Mini-Spinner panels. The ideas above are just a few of the many points about ecology that you can bring up.

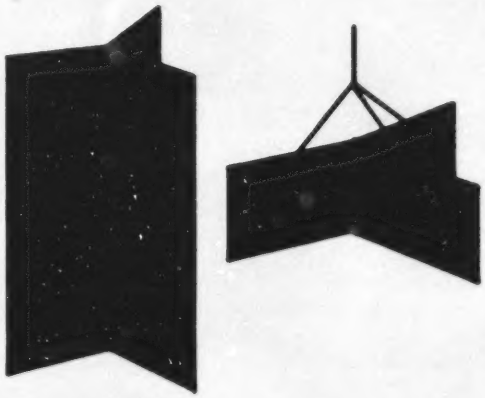
2. Show students how to assemble their Mini-Spinners. Directions are on the first of the two student sheets. By assembling their Mini-Spinners, students will get a feel for constructing larger table-top or free-standing displays based on the Mini-Spinner design. You might suggest that they use a minimal amount of paste when putting their Mini-Spinners together. If they use too much paste, the paper will pucker.

3. To complete the activity, form groups of six students. Give each group the task of designing and assembling a large Y-shaped display using either corrugated or smooth cardboard. Your students should develop their own slogans and create their own art. You might have each group develop a display on a specific topic such as *conserving energy, air pollution,* or *water pollution.*

Additional activities

1. Arrange to have your students' displays exhibited in a school corridor or assembly room.

2. Inquire about placing some of the most thought-provoking designs in the window or lobby of a local store or bank. If possible, have students accompany the display to discuss the slogans with interested shoppers. Students might pass out information sheets on local recycling programs, lists of recommended ecological activities, litter bags, or other material to encourage citizen action for a better environment.



Unit 2-Let's look at a food chain

Activity Masters 3, 4 and 5

Background Ideas

This unit discusses nature's food chains—the natural cycles that plants and animals depend on to sustain life. The unit also shows what can happen when people break the chain—disrupt the natural cycle—by destroying a link.

A food chain is a graphic representation of one of the most complex relationships found in nature. Simply stated it shows the relationships of plant and animal organisms that depend on one another.

If students understand the relationships in a simple food chain they will better understand the basic issue that underlies countless environmental debates. This basic issue is whether human disruption of the balance of nature will have serious environmental consequences. By understanding the concept of natural cycles—exemplified by the food chain—students will see that a change at one point in any natural cycle will almost always result in changes at other points.

The simplified food chain which is studied in this unit is a teaching device from which much detail has been eliminated for the sake of clarity. A totally complete chain would have so many variations that arrows would go in countless directions, crossing and recrossing so that a properly drawn food chain would look more like a puzzling maze than a picture explaining plant-animal relationships.

The very nature of this complexity helps insure survival in nature. If one organism in a chain becomes scarce, another can often assume its role. Such variables provide for checks and balances and, in short, help insure the balance of nature.

This balance can, however, be destroyed by people (and sometimes by nature itself). The fact that human actions can destroy the balance of nature is fundamental to any understanding of why pollution must be avoided.

Many environmental issues are, of course, questions of values rather than questions of science alone. For example, the debate over strip or surface mining of coal is not just a scientific issue. Few people question that such mining disturbs the ecology of the areas in which it is done. The major issue is whether the possible damage to ecological balance is outweighed by the benefits which can result from this large source of badly needed energy.

This unit does not attempt to deal with such value issues; its goal, rather, is to establish the basis for a better understanding of such issues. The point that should be made to students is that when it is necessary to disrupt the balance of nature, people should have the foresight and concern to minimize that disturbance. Students should come to recognize that people are part of nature—not its conquerors—and that we must learn to live in harmony—not in conflict—with nature's laws.

Using the transparency

The transparency shows three of the four members of the food chain under study—green plants, a plant-eater (rabbit), and a meat-eater (fox). Decomposers—the fourth member—are not shown on the transparency. Their role, however, is discussed in the questions below. By reading these questions you will be able to acquaint yourself with the role of each member in the chain. Since the role of decomposers will probably be least familiar to you and your students, you may want to give special attention to it. You might, for example, indicate these on the transparency with a transparency marking pen in the course of your discussion. These decomposers could be represented by small insects or worms. By drawing these you should be able to give special emphasis to the role decomposers play.

Questions:

1. What living things do you see in the picture? *Rabbit, fox, grass, tree.*
2. Are there any things that you can't see that would probably be living in the tree or in the ground? *Birds, insects, worms, micro-organisms.*
3. What would happen if you took the rabbit away from the field and put it in a cage? What would it need to stay alive? *Food, clean air and water.*
4. What does the rabbit need to stay alive in nature? *Same answer as question 3 and shelter.*
5. What does the rabbit eat? *Green plants.*
6. Why does the rabbit need food? *For energy, growth.*
7. Why does a plant need food? *To keep alive and grow.*
8. How does a plant get its food? Does anyone know? *With the help of sunlight it makes its own from air, water, and chemicals in the soil.*
9. Does the rabbit in the picture have an enemy? *The fox. Note that some animals, such as the fox and hawk, are called predators—meat-eaters that catch other animals alive and feed on them.*

10. What's important about insects and worms? What do insects and worms eat? *Explain that certain insects and worms are called decomposers. They feed on wastes of plants and animals and on dead plants and animals. They also break down wastes through their digestive systems into simple chemicals that plants use in making food.*

11. As you study plants and animals in the picture, can you see a food cycle that exists when there is a balance in nature? *From the green plant to the plant-eater (rabbit), to the meat-eater (fox), to the decomposer, and back to the green plant.*

12. A major change in one part of the food cycle endangers all parts of the cycle. For example, if a hunter kills all foxes in a woods, would this be good for rabbits? *No, because it would cause an overpopulation of rabbits. Eventually the rabbits would eat all plants in the area. With the plants exhausted, the rabbits would then starve.*

13. Can you see the value of predators? *They keep down the population of certain animals and help maintain a balance in nature.*

14. Could there be a food chain without decomposers? *No.*

15. Could there be a food chain without green plants? *No.*

16. Could there be a food chain without plant-eaters or meat-eaters? *Yes. Animals are not essential to a food chain, but plants and decomposers are.*

17. How does air and water pollution affect the cycle? *To grow and thrive, plants and animals need clean air and water.*

18. How does a forest fire affect the cycle? *By destroying trees and ground cover, a forest fire destroys food and shelter for animals.*

19. Name ways that people can help to maintain nature's balance. *Students should have many suggestions.*

Using the activity masters

Activity Master 3 presents a wheel that shows the four members of the food cycle. The wheel is designed to be cut out and assembled with the slider, also printed on Activity Master 3. The wheel illustrates relationships between members of the chain.

Activity Masters 4 and 5 present questions and answers about these relationships. These masters have been designed so that students can use the food chain wheel for self-instruction. Each master gives students one of two directions: cover the answers with a separate piece of paper before answering the questions, or fold the question page in half to conceal the answers.

Questions on Activity Master 4 can be answered without the slider.

Questions on Activity Master 5 can be answered with the help of the slider which is easily attached to the wheel. To give extra strength to the slider, you might direct students to paste the wheel on thin cardboard. Caution them to use only a minimal amount of paste. If available, rubber cement is a better adhesive for this purpose than paste. It doesn't pucker the paper.

Definitions

You may want to use the following terms in your discussion. Students should be familiar with them if they use other resources to study the food chain.

photosynthesis—the process by which a green plant makes sugar, part of the food it needs to grow.
herbivore—a plant-eater.
carnivore—a meat-eater.
predator—a meat-eater that captures its food alive.
omnivore—an animal that eats both plants and animals.
producer—an organism that produces its own food; a green plant is an example.
consumer—an organism that eats food produced by another organism.

Additional activities

1. Take a nature walk to look for members of food chains. Students can make a list of different meat-eaters, plant-eaters, green plants, and decomposers that they see. If a student has a camera, ask him or her to take pictures. Students can use the photographs to illustrate a large food-chain wheel for a bulletin-board display.

2. Build a classroom terrarium—an excellent way to show the interrelationships of a community of living things. Detailed instructions for building a terrarium can be found in the teacher-guide sections of some science textbooks. Terrariums can also be purchased in flower stores, department stores, and from garden centers.

Unit 3-Drip the water drop & Save Me

Activity Masters 6, 7, 8, 9

Background Ideas

Health Authorities Ban Lake Swimming!

PCB Found In Fresh Water Fish!

Drinking Water Endangered In Ohio River Cities!

A few years ago, beaches on the Great Lakes were declared unsafe for swimming. Tons of fish from those same lakes and the oceans were withdrawn from sale because of contamination. A number of cities found that their drinking water supplies were in danger. Perhaps most serious, water pollution appeared to be affecting the earth's life-sustaining food cycle.

Our entire way of life contributed to water pollution —factories dumped wastes into rivers, cities discharged sewage into rivers and lakes, homeowners used appliances like clothes washers and automatic dishwashers that flushed detergents into rivers and lakes.

While the United States' water pollution is still very serious, people, government and industries working together have made some encouraging progress. Following pure-water legislation, many companies are finding ways to cleanse water from their manufacturing operations before returning it to rivers and lakes. Others are reducing water contamination by recycling the water they use.

Between 1961 and 1974, water pollution at 87 locations was measured by the government. During those years, locations falling into the "very poor" and "severe" categories in regard to conditions affecting acquatic life (fish) dropped from 16% to 3% and, in relation to drinking water safety, from 10% to 1%. That means that the *very worst* sources of water pollution are being controlled.

Some very serious problems remain. The building and maintenance of adequate water and sewage treatment facilities will require billions of dollars in the years ahead. High levels of nitrogen and phosphorous continue to reduce oxygen and thus endanger water life in inland lakes. As late as 1975, the sale of some Great Lakes fish was still discouraged because of contaminants.

How can the average citizen help to solve the nation's water problems? An answer to this question comes from an engineer in a municipal water purifying plant:

"Each one of us can help the problem by a very simple action—using only as much water as we need. Because water has been so cheap for so long, most of us have developed bad habits when it comes to using water. We can really get by with less. If we conserve water we will relieve demand on our water purifying plants.

"It's true the amount of water saved by our reducing domestic usage may be small compared with what industry can save, but it can be significant."

This unit discusses ways that your students can save water at home. As noted above the amount of water to be saved in the homes of America may seem small compared with what industry can save through recycling or by changing manufacturing procedures. But there can still be significant value for students to become aware of how much water they use, and to learn ways to use only as much as they need.

Water is one of our most basic natural resources. If students can learn to use this resource with care, they will hopefully develop habits and attitudes which will carry over into the use and care of other natural resources.

Using the activity masters

DRIP the water drop

Many intermediate-grade students have little idea of where the water they use at home comes from and where it goes after it is used. Although children in these grades usually study the natural water cycle, their study is seldom related to domestic water use and water pollution. Activity Masters 6 and 7 fill in that gap. They are designed to make two basic points:

- The water we *borrow* from the natural water cycle should be returned to that cycle in as pure a state as possible.
- By borrowing *less* water from the cycle, we can reduce pollution by reducing demands on water-treatment facilities.

On the master, students will read that nature has its own methods of purifying water. (Dilution, bacterial action, and filtration through the ground cleanse water naturally.) But if the water is too dirty, nature's methods simply can't cope.

The two masters also provide study projects which answer the following questions:
Where does the water you use come from?
Is it purified before or after you use it?
Where does water go after you use it?
How do steel and paper companies use water?
How does nature purify water?

These masters can also be used to introduce textbook units on nature's water cycle and to set up single-student or small-group projects. As part of the study, consider arranging a field trip to a water or sewage-treatment plant or to a local manufacturer or public utility plant that uses pollution control equipment.

Save me!

Activity Masters 8 and 9 help students visualize the amount of water they use and encourage them to think about ways they can save water. When you use the chart on Activity Master 8, remember that the figures are only estimates. Answers for activities 3 and 4 from Activity Master 9 follow.

Activity 3.

More vs. less

Several answers are possible for each of these questions. Among them are the following:

I CAN SAVE WATER WHEN I BRUSH MY TEETH by not letting water run constantly.

I CAN SAVE WATER WHEN I SPRINKLE THE LAWN by watering at night when the evaporation rate is low.

I CAN SAVE WATER WHEN I WASH DISHES in an automatic dishwasher by making sure I have a full load.

I CAN SAVE WATER WHEN I GET A DRINK by keeping a jar of cold water in the refrigerator. Then I won't have to let the water run until it gets cold.

Activity 4.

Can you solve this problem?

Answer: 12 gallons of water divided by four people in a family equals three gallons saved per person per day. Three gallons times the U.S. population of 200,000,000 equals 600,000,000 gallons saved.

Some students will not divide 12 by four before multiplying. This is the "trick" referred to in the student instructions.

To help students appreciate how much water this small savings per family represents, tell them that 600,000,000 gallons of water would fill a train of tank-cars 430 miles long—more miles than the distance between Washington, D.C., and Boston, Massachusetts.

Additional activities

Here are two activities for your students. One illustrates the quality of water we see around us every day. The second illustrates how nature cleans water by filtering it through the ground and eventually returning it to the rivers and lakes we use for our water supply.

1. Water in nature

Collect fresh rainwater in a jar. Fill a second jar with water from a ditch or gutter. Fill a third jar with water from a lake, river, or pond. You will also need a fourth jar filled with drinking water. Paste labels on these jars to remind you where the water came from.

Put the jars in a safe place so they won't be disturbed. Be sure not to shake them.

After a couple of days, check to see if any debris has settled near the bottom of each jar. Evaluate each jar according to the chart below.

	Color	Smell	Drinkable	Debris

2. Make clean water nature's way

With this project, students can duplicate nature's water filtering process.

Place a plug of cotton in the hole of a flower pot. Add layers of sand and charcoal. Pour muddy water into the pot, allowing it to drain out into a glass jar.

What does the water look like when it runs out? Students can write a sentence or two to describe its appearance.

What happened to the debris in the water? Has it stayed in the pot?

Does this give you an idea of how nature cleans water by allowing it to filter through the ground?

Unit 4-A very short history of trash and How paper is recycled

Activity Masters 10 and 11

Background Ideas

"This greeting card is made from 100% recycled paper."

City to Open New Trash Recycling Plant."

"...take your paper, cans, and bottles to the Recycling Center, Fifth and Main, on Saturday between nine o'clock and noon."

Americans have learned a new meaning for an old word—recycling. We read it on birthday cards, in newspaper headlines, and hear it on radio and TV.

What is recycling? Why has is become so important?

Recycling means the reuse of materials that we have discarded after using them in their original form. Today, recycling is important for two reasons: first, America is running out of raw materials to make new products, and second, our trash—the refuse of our affluent society—threatens to overwhelm us.

Natural resources

In May 1973, the U.S. Geological Survey published a report on America's raw material reserves. After years of plenty, the report stated, our rapid industrial growth has seriously depleted our reserves of nearly all key materials.

The U.S. has run out of chromium and manganese—vital in steel manufacture—and now, after decades of self-sufficiency, we import half our aluminum, nickel, tin, and zinc.

Is there any way to reduce this drain of our raw materials?

The report suggested four possible ways: conserving present ore reserves, locating new supplies of raw materials, developing economical ways to extract minerals from low-grade ores, and recycling.

Recycling may be optional for most Americans, but for manufacturers recycling has already become a way of life. Recycling provides a source of raw materials for production lines.

More than 60% of all copper scrapped annually is retrieved.

Nearly half of all aluminum products produced annually are salvaged for reuse.

A quarter of all steel produced in the U.S. each year and about one-fifth of all paper products are reclaimed.

Besides reducing the drain on our natural resources, recycling helps with another national problem: our growing piles of trash.

Trash in America

Affluence is not without its problems.

An industry study once estimated that if America's annual 360,000,000 tons of trash from homes and industry were piled on Manhattan, New Yorkers would be buried 13 feet deep in this stuff. In one year, each American tosses out a ton of trash.

Where does it all go?
80% is piled in dumps
10% is burned in incinerators
5% is buried in landfills
5% is converted to fertilizers, flushed down disposal drains, or salvaged for recycling.

So far, these disposal methods haven't worked very adequately. Dumps are eyesores. Landfills are expensive—New York City now must buy 200 acres a year to bury trash. Incinerators usually cause air pollution.

"When communities are faced with these disposal problems," one city official said, "recycling becomes an appealing solution. But recycling has its problems, too. It's not a free ride."

Officials across America agree. So far recycling has fallen short of overcoming two critical problems: sorting and the high cost of producing new products from recycled materials.

While the cost of recycled materials varies from time to time and from place to place, they frequently cost more than equivalent raw materials and thus tend to raise the cost of the products in which they are used.

Sorting each piece of trash into its reusable elements is a king-size problem. Bottles must be sorted for quality and color. Cans present another problem: a steel body, a seam of tin and lead, an interior coating of lacquer, zinc, or tin depending on a can's contents. In a smelter, all these materials melt and contaminate each other.

With some recycled material, quality also becomes a problem. Recycled copper is as good as new, but the quality of recycled paper drops a step. Recycling causes paper fibers to shrink. Consequently, recycled paper is weaker than comparable paper made from virgin fibers.

Nor can all paper be recycled. Some ink, binders, and wax or plastic coatings resist recycling. Paper used for food wrapping is an example of paper that must be disposed of in ways other than recycling. (Another problem for food distributors: the government restricts the use of recycled paper for food wrapping because chemicals contained in the recycled paper may migrate to the food.)

As an industry, recycling has problems. But most authorities agree that, in time, recycling will be an important solution to America's twin problems of dwindling resources and growing mountains of trash.

A more recent solution to the problem of trash is that of using it as a fuel. This is done in two principal ways. When glass and metal have been removed, solid waste materials can be burned to produce electricity, steam or hot water. Or solid waste can be converted into gas or oil by a process called pyrolysis, which uses high heat in an oxygen-free environment. In a test program conducted in St. Louis from 1972-75, enough electric power to serve 25,000 homes was generated by mixing garbage with coal. Presently, more than thirty cities in the United States are operating, building, or planning solid waste energy systems. Connecticut expects its statewide garbage-to-energy systems to process 84% of its garbage and to produce 11% of its electrical power by 1984. Like recycling, garbage-to-energy programs can help to solve two major national problems—trash disposal and the need for new sources of energy.

Using the activity masters

Have students read and discuss *A Short History of Trash* (Activity Master 10). Then go on to Activity Master 11, *How Paper is Recycled,* a puzzle that illustrates the essential steps in paper recycling.

Direct your students to cut out the nine wedges. The pieces can then be assembled into a pie to show the steps in a paper recycling process. Each wedge is identified with a letter. The correct order of wedges follows the letters in the word R-E-C-Y-C-L-I-N-G.

The process of reducing paper products to pulp and remaking it into new paper requires a few words of explanation. Not shown here is the sorting process. After collection, paper is separated into various grades—newsprint, stationery, magazines, cartons, and cardboard. Each grade is recycled by itself to avoid contamination from other grades. For all grades, though, the recycling process follows the same steps shown in the puzzle.

After sorting, the first step in the recycling process is "de-inking." This step removes coatings, clays, inks, and binders from the waste paper. The cleansed paper then passes on to the hydropulper, a huge vat, where it is cooked in water and acids and stirred. The hydropulper reduces the paper to pulp—tiny wood fibers suspended in water.

A pipe in the bottom of the hydropulper drains the wet pulp and pumps it onto a screen. Gently vibrating, the screen levels the pulp into a flat mass.

Next, heated drums squeeze and dry the pulp into new paper or cardboard. Winding the fresh paper into huge rolls and transporting it to paper users make up the final step.

Additional activities

1. Find out how materials other than paper are recycled. You might assign small groups of students to find out what steps are involved in the recycling of glass, aluminum, steel, and rubber. Have the groups make bulletin board displays, using a pie-shaped design, showing the steps involved.

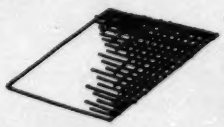
2. Recycle your own paper. Recycling paper commercially requires huge machines and elaborate production lines. You can, however, demonstrate the basic steps of paper recycling in your classroom—or students can perform the same project at home.

The materials you will need are: an old newspaper, mixing bowl, egg beater, a wood block, a square of window screen (about 3-4 inches on each side), a plastic sandwich bag, wallpaper paste or corn starch, water and a tablespoon.

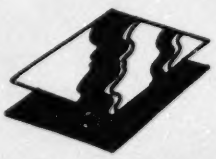
1. Fill the bowl about one-quarter full of water. Tear a half page of newspaper into tiny pieces. Place the pieces in a bowl and let them soak for one hour.

2. After the paper has become thoroughly soaked, beat it with the egg beater. The action will break up the paper into fibers. When the mixture has been thoroughly beaten, it should have the creamy texture of paper pulp.

3. Dissolve two heaping tablespoons of wallpaper paste or corn starch in a pint of water. Pour into the pulp. Stir. (The paste or starch acts as a binder between the wood fibers suspended in the mixture.)



4. Hold the piece of window screen flat and lower it into the pulp. Do this repeatedly until you accumulate a layer of pulp about 1/16th inch thick.



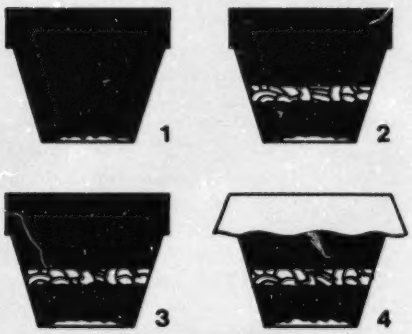
5. Set the pulp-covered screen on a newspaper and place a plastic sandwich bag over it. Press down with the wood block—gently at first, then with more pressure. The water will filter through the screen onto the newspaper.

6. Allow the fibers to dry for about 24 hours. Peel the fibers—now paper—from the screen. Congratulations! You have just completed the process of recycling paper.

3. Demonstrate nature's way of recycling. Nature has its own way of disposing of some trash. You can demonstrate this process in your classroom. The process takes two or three weeks to complete, so you should allow for this length of time.

You will need a large clay flower pot, top soil, a few small stones, and a collection of typical litter—pieces of newspaper, plastic, a strip of tin can (or a small piece of steel wool without soap), broken glass, a few potato peels or pieces of bread.

1. Cover the hole in the bottom of the pot with the stones. Fill about one-third full with topsoil.
2. Add a layer of the litter you have collected.
3. Cover the litter with a layer of top soil until the pot is two-thirds full. Sprinkle with water, but don't soak.
4. Cover the pot with a piece of plastic. Set it in a warm, dark place. Keep the soil moist.



5. After two or three weeks, dump the contents of the pot on a newspaper and with a trowel spread it out. What trash has decomposed? What buried litter didn't decompose? What does this tell about the problem of litter and trash? You might want to return the material to the pot and examine again in three weeks to see what further decomposition has taken place.

4. Collect recyclable materials. On their own—or as a school project—students may want to collect trash that can be recycled, such as paper, cans, bottles, or scrap metal. Before beginning a project like this, however, be sure you have a buyer—or recycling center—which will accept these materials. Prices paid for such materials vary with time and location.

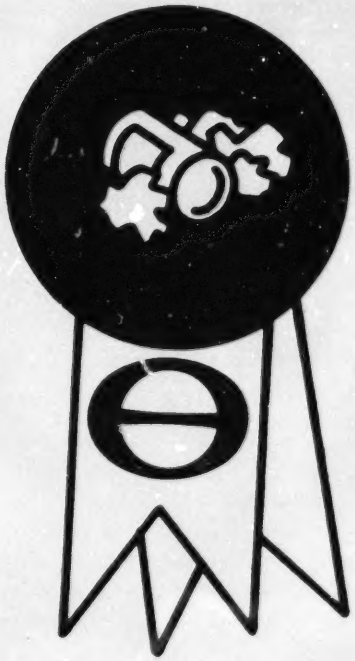
Unit 5 - Be an ecology champion

Activity Master 12

Using the activity master

The theme of personal responsibility has run through each unit in this book. This activity has been designed to help students think about the variety of environmental activities they can personally take part in. Everyone, the activity says, can be an ecology champion—someone who shows his or her concern through action.

Students can do this activity in class or at home. Directions are printed on the activity master. Some ideas for ecology badges students may want to make on their own are: Water Saver, Bottle Recycler, Can Recycler, Animal Protector, Tree Planter.



Additional activities

Careers in ecology

You might use this unit as a taking-off point for a study of careers in ecology. For example you might have students find out about people in their own community who have occupations related to ecology or the environment. Such people might be identified by contacting governmental agencies, large companies, museums or universities and asking whether anyone working for them has a full-time job related to the environment. Is there someone responsible for air pollution control? Energy conservation? Is there someone who does research on environmental problems? What does this person do? Why? Could they speak to your class or school about their work?

Students might also learn about careers related to the environment through a close reading of daily newspapers. You might, for example, assign a small group of students to read a daily paper carefully for a week or more. Have them look for any articles which discuss the environment or energy. Then have them report to the class about people described or mentioned in the articles. Can they tell anything about the jobs these people have. Were these people responsible for making laws? For enforcing laws? Or were they scientists or naturalists studying the laws of nature? Such an activity can open up a variety of discussions on careers as well as the problems that people in these careers deal with.

Discussion questions

In this section, we'll discuss students' values in the area of conservation and ecology.

A "value" is an abstract idea. What is a "value?" How can you illustrate it for your students?

Here's a suggestion:

On the chalkboard, write the following list. Ask your students to copy it. Then ask them to number the items in each set in order of importance—one, two, three. Each student should do this individually.

1. Bike
   Comic books
   Clean air
2. Plants
   Cars
   Ice Cream
3. Clean water
   Swimming
   Boating
4. Summer vacation
   Fresh air
   Ten dollars

Each of these items has a value. When we list them one, two, three, we say what is important to us and in what order.

Most young people say, "Sure, I want clean air and water!" These are values, too, and they're important to youngsters. But putting these values into action is often another story.

For example:

Belching smoke stacks are seen much less often in the United States since the passage of the Clean Air Act in 1967 and the amendments of 1970. Industries have installed devices to help clean smoke before it reaches the air. But air pollution caused by industries (particularly those that are returning to coal as an energy source) is still a significant problem.

Take the case of a utility company whose smoke stacks raise the air pollution level of a city. On a warm summer day when people all over town turn on air conditioners, the company must burn more fuel to produce more electricity to run those air conditioners. More fuel, more pollution. Such a situation raises questions of value for consumers as well as industry. The question for industry is whether it is willing to give up some profit in order to develop and install additional anti-pollution equipment. The question for consumers is whether we are willing to give up the comfort of a cool home on a hot day for the greater value of unpolluted air. It's a matter of values.

To bring home the point, you might pose these questions to your class:

"Would you give up TV or air conditioning for three weeks if you knew it would help conserve electricity?"

"Would you be willing to give your free hours next Saturday to collect newspapers for recycling?"

"Would you give up buying a game or toy—something you really want—if you knew the maker of the game was not following anti-pollution guidelines? The company might, for example, be pouring its waste into a river or its smoke stacks might be polluting the air of a city."

"Would you ride a bus or give up a trip to the movies in the family car to reduce air pollution (the automobile is the largest single cause of our country's air pollution)?"

Each of these instances poses a question of values—to weigh our own comfort and convenience against a larger good. And basically that's what conservation is all about: a matter of values—what's important to us and what we're willing to give up for the good of our community and country.

Unit 6-Buzzy Bee's easy guide to energy

Activity Masters 13, 14, 15 and 16

Background ideas

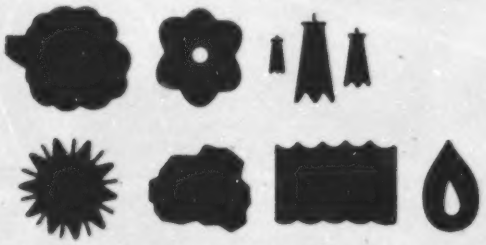
"Energy companies have caused the energy crisis."
"Environmentalists are holding up progress."
"People just refuse to face up to the fact that we must consume less."

Such statements are heard daily in America as group blames group for the energy crisis: the energy companies are to blame, the conservationists are to blame, American consumers and our way of life are to blame.

Responsibility, no matter which option we choose, finally rests on each one of us. Energy companies work to supply us. Conservationists, who sometimes suggest radical changes, do so for us. And we, the consumers, are the ones who benefit from energy-using conveniences.

Instead of looking for someone else to blame, we should be taking positive steps to solve the problem. For the short-term, each of us should evaluate his or her personal energy use. We should establish criteria for the spending of our energy "allowance" which will give us what we want without wasting.

For the long-term we must act on the basis of the unavoidable fact that fossil fuels (oil, natural gas, coal) are limited. No matter how much oil we import from abroad we must recognize that we all live in the



same single world, and one day that world's supply of oil will run out. In preparation for that day we need to encourage the investment of large amounts of money and research to find a reasonably priced, clean, safe and inexhaustible source of power. While we are finding it, of course, we must protect the air, the water, and the land from contamination if we are to have a fit place in which to enjoy this new energy.

Using the activity masters

(Activity Master 13)

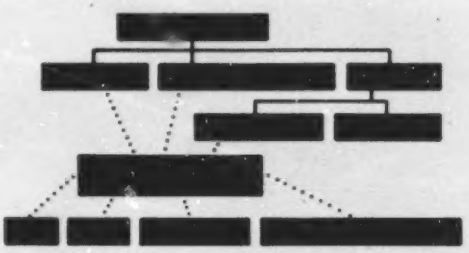
I'm Buzzy the Energy Bee

The first activity master, while concentrating on fossil fuels, makes students aware of the different sources of energy in the world—some of which are more available and usable than others. The great problem of the future is to make more of these sources more available at a cheaper price.

Before you distribute the spirit master copies, ask students what kinds of energy they are most familiar with in their lives. They will probably mention electricity, gasoline, and some kind of heating fuel (natural gas or heating oil). Write these on the chalkboard: gasoline, electricity, heating oil, natural gas. From there, fill in the following chart that shows primary sources and the various secondary forms that are derived from them. The dotted lines show which fuels produce electric power. Add the percentages showing the contribution each makes to the U.S. energy supply.

Such a chart makes apparent our dependence on fossil fuels. (Explain to your class that a fossil is the remains or a trace of an animal or plant that lived millions of years ago. Fossil fuels—natural gas, oil, and coal—were formed from the remains of prehistoric plants and animals over a period of millions of years.) Because we assumed that fossil fuels would always be abundant and cheap, we were slow to begin research on alternative sources, which today account for only 6% of our total energy supply.

Most of us are now very much aware that fossil fuels are becoming increasingly scarce and expensive. While the use of most alternative energy sources is delayed by technological, economic or ecological problems, scientists are working diligently to solve those problems.



Presently, the largest amount of research is directed toward nuclear energy. Some people feel that the problems of disposing of radioactive waste and of safeguarding the plutonium that nuclear breeder reactors produce—which can be used to make bombs—make its use too great a risk. (These problems may eventually be solved by the development of a nuclear process called *fusion*.) Others feel that the benefits of nuclear power outweigh the risks.

Solar energy research is expanding rapidly. Energy from the sun may become economically feasible for heating and cooling a significant number of homes within the next ten to twenty years. The production of electricity from the sun's energy appears to be further away.

Other possible energy resources, still with many unsolved problems, include geothermal (heat from the earth's center), wind power, energy produced from garbage, coal changed to gas or liquid form, the extraction of oil from shale rock, and bioconversion (converting green plants to gas, oil, or electricity).

Most people agree that we are likely to be dependent on fossil fuels for much of our energy for many years to come. The activity master treats the double problem: supplies of fossil fuels on our planet are limited (students will be aware of recent oil and natural gas shortages); and the use of oil and coal can contribute to air and water pollution. Many people believe that the solution is also a double one: to use coal (our most plentiful fossil fuel) under the cleanest possible conditions for the present and to develop alternative sources of energy at the fastest possible rate. Perhaps a student you are now teaching will become a scientist and one day participate in the search for that source.

Answers to questions on Activity Master 13. The names for the drawings are 1) wind; 2) atom; 3) oil; 4) sun; 5) coal; 6) water; 7) natural gas. Some children may not be familiar with the atomic symbol. Its presence among the pictures should provide an opportunity to discuss that relatively new energy source. You might have some interested students study more about it and give a report to the class.

The three present sources of energy which cannot be used up are the sun, the wind, and water.

Energy Home (Activity Master 14)

Community, commercial, and industrial conservation is important. Forty percent of our country's energy use is accounted for by industry, 31% by transportation, 18% by commercial uses, and only 11% by residential uses. It is in the home, however, that children are most readily able to conserve energy. Children's efforts to conserve energy are significant now and will become even more significant as they become larger consumers. In addition, the interest of your students in saving energy may stimulate similar interest in their families.

During the 1970's the automobile was the largest consumer of energy (40%) used by American families (residential uses plus private automobiles). Home heating (39.4%) was a close second, followed by water heating (8.8%), cooking (2.6%), air conditioning (2.3%) and lighting (2%).

Among the many appliances pictured, especially heavy users of energy (given in terms of average annual kilowatt-hours) include the air conditioner (2000), light bulbs (1870), range (1550), clothes dryer (1200), and food freezer (1200). Appliances that might be considered moderate energy consumers are the frost-free refrigerator (750), color TV (540), black/white TV (400), dishwasher with heater (350), frying pan (240), iron (150), electric blanket (150), and automatic washer (100). Light users of energy would include the vacuum cleaner (45), toaster (40), radio phonograph (40), radio (20), clock (17), hair dryer (15), mixer (10), sewing machine (10), shaver (.6), and can opener (.6).

Energy conservation should be thought of in relative terms; for example, while the many small appliances around most of our homes may seem wasteful, some of them are more efficient than larger energy users. Using an electric blanket uses much less energy than heating a whole house at night. Cooking in an electric skillet, slow cooker or even the oven (if several dishes are being cooked) may be more efficient than using the burners of the range. A fireplace may actually waste energy in a gas-heated house.

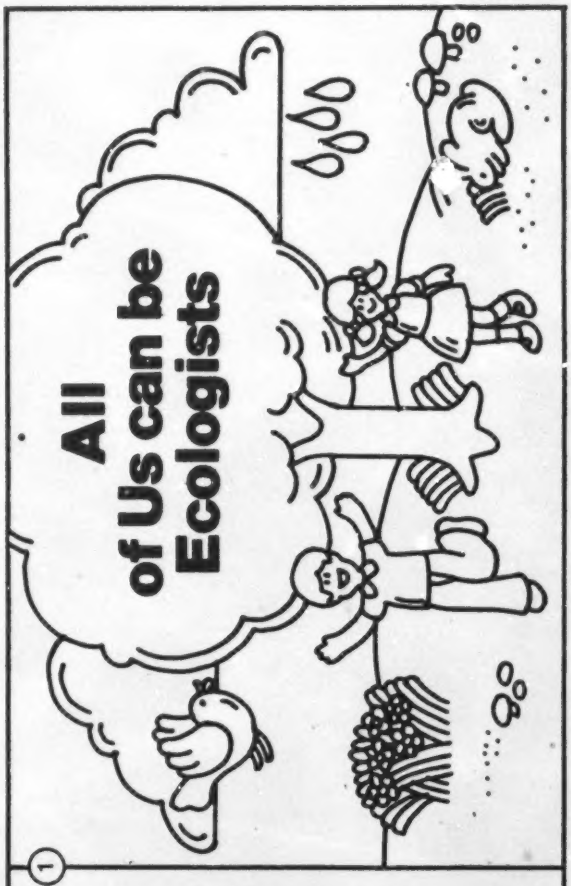
When students have completed the exercise presented by the master, have them continue the activity by listing the energy-consuming items of the Energy Home on the left side of a separate piece of paper. On the right side of the paper, opposite each item, ask students to list ways that the energy used could be reduced. Be sure to point out areas in which children themselves can save energy without help from their families. Some of those areas are marked with an asterisk on the sample list below.

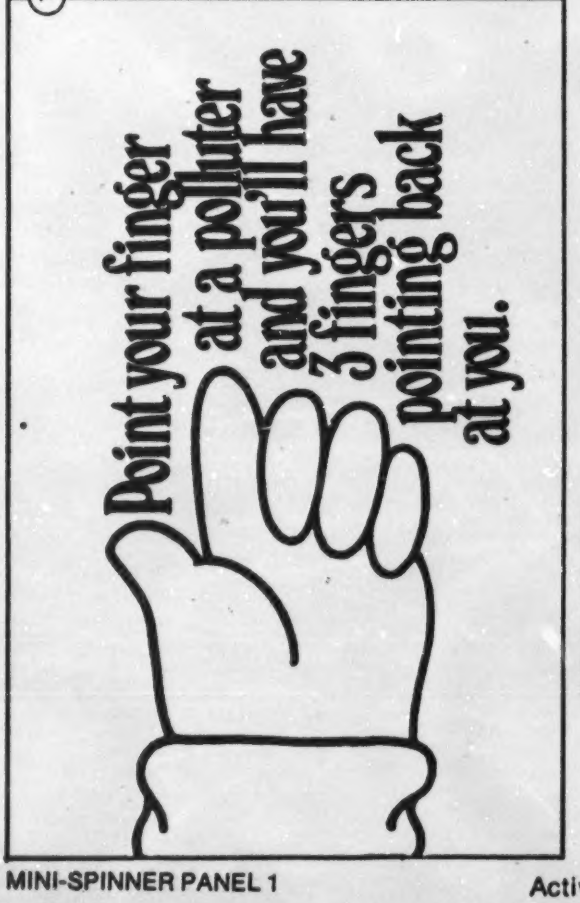
1.	Television, Lights, Radio	Turn off when not using*
2.	Range	Cover pots; cook thawed foods
3.	Washer	Wash full loads; use cold water
4.	Car	Ride bike,* walk,* use car pools, observe speed limits, keep car tuned
5.	Bathtub	Shower or use less water*
6.	Outside doors	Close when using heat or air conditioning
7.	Thermostat	Turn down
8.	Fireplace	Close flue when not in use*
9.	Insulation and storm windows	Install
10.	Windows	Close draperies at night, open when sun is shining in*

Buzzy's Easy Energy Slider (Activity Masters 15 and 16)

The real purpose of the Energy Slider is not to test the students. Since they are putting the slider together, they will see all the answers on the question/answer page anyway. Rather the purpose is to give them important information painlessly. If children can test friends, siblings, and parents on the information, they are almost sure to remember it themselves.

continued on inside back cover

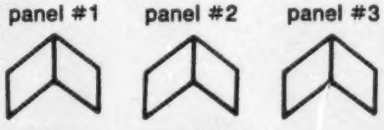




Make your own ecology mini-spinner

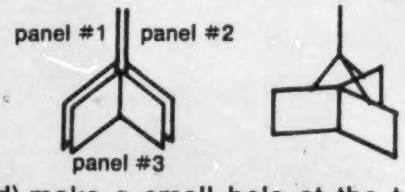
1 Read the six slogans on the Mini-Spinner panels on this page and Activity Master 2. Think about each slogan. Then discuss them in class or with your family at home. Do you agree with the slogans? If so, why? If not, why not?

2 Cut out the three Mini-Spinner panels (You may want to add color to them before cutting.) Then assemble your Mini-Spinner as shown below:
a) fold each panel along the middle line;



b) paste or tape half of panel #1 to half of panel #2;

c) then paste or tape panel #3 to the unattached halves of panels #1 and #2;



d) make a small hole at the top center of each panel. Then pass a string through each hole, being sure to knot the end of the strings. Tie the strings together and attach to a longer string. Your Mini-Spinner is now ready to hang at school or home.

3 Now that you have your own Mini-Spinner, you can use it as a model for constructing a Maxi-Spinner or a free-standing display. Use poster board or corrugated cardboard to make the display. You might make a Maxi-Spinner for hanging, as a table-top display or as a free-standing display.

MINI-SPINNER PANEL 1

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MINI-SPINNER PANEL 2

Activity Master 2

MINI SPINNER PANEL 3

RECYCLING SAVES RESOURCES

2

Put litter in its place

AFTER CUTTING FOLD HERE

3

A flower seed is a great investment. Plant one and see the returns.

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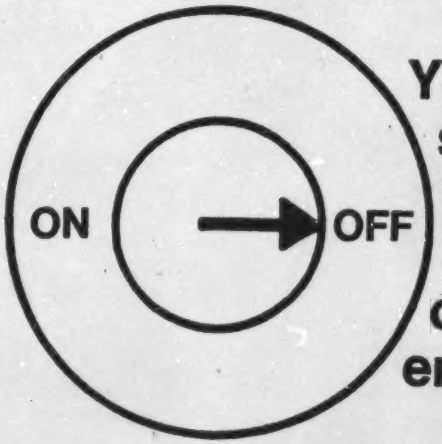
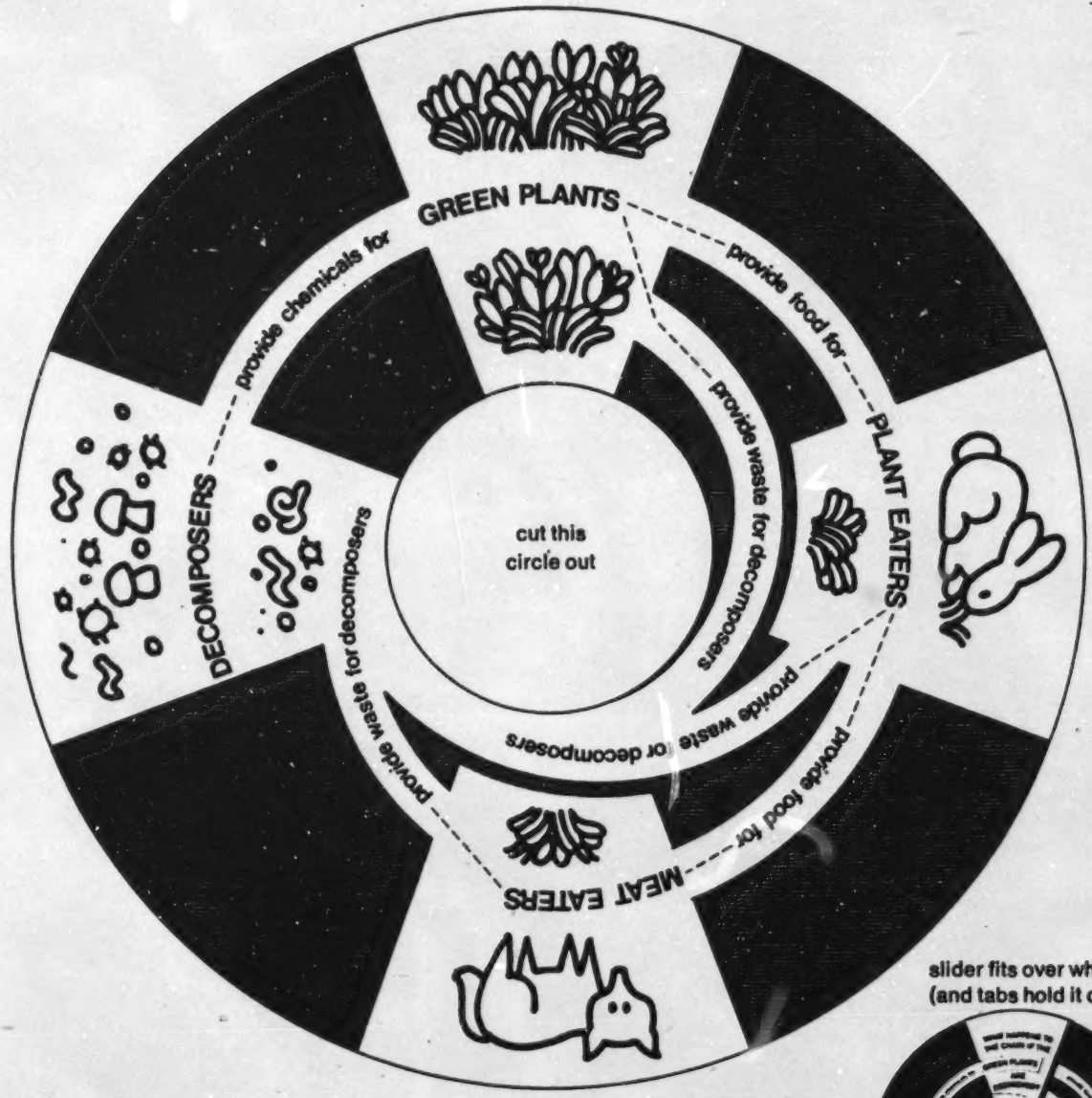


You can serve your world if you conserve energy.

Let's look at a food chain

M ©1977 McDonald's Corporation

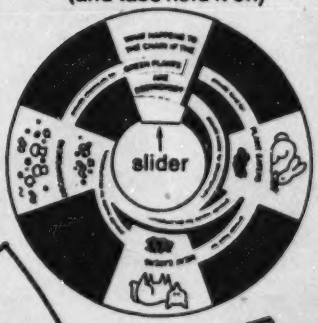


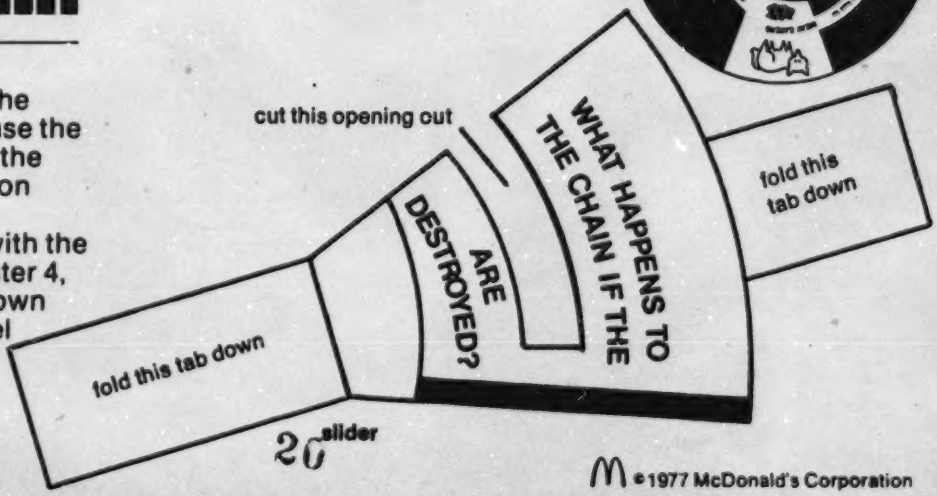
Let's look at a food chain

Directions

1. Cut out the wheel and the circle in its center. Then use the wheel as you try to guess the answers to the questions on Activity Master 4.
2. After you are finished with the questions on Activity Master 4, assemble the *slider* as shown below. Then use the wheel and the slider to answer the questions on Activity Master 5.

slider fits over wheel
(and tabs hold it on)





Activity Master 3

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Let's look at a food chain

Can you guess the answers to the following questions? Before you try, cover the answer column below with a piece of paper or fold the paper in half so you cannot see the answers. After you think about *your* answer to each question, look at the answer that is given. Use the wheel from Activity Master 3 to help you think about your answers.

Questions

1 Look at the wheel. Can you tell how *plant-eaters,* such as the rabbit, get their food?

2 Where do *meat-eaters,* such as the fox get their food?

3 Many animals are both meat-eaters and plant-eaters. Do you know the names of any of these animals? (This answer is not on the wheel.)

4 Find the word *decomposers* on the wheel. Can you guess the names of some decomposers?

5 What do the decomposers eat?

6 After the decomposers break down the wastes into simple chemicals what are these chemicals used for?

7 The food cycle shows how living things get their food. Can you think what else living things need besides food?

Answers

1 This is an easy one! Plant-eaters eat green plants.

2 This is an easy one too! Meat-eaters eat other animals.

3 Some of these animals are pigs, chickens, sea gulls, bears—and *you.*

4 Some of the decomposers are certain insects, worms, molds, fungi, and bacteria that live in soil and water.

5 Decomposers eat wastes from plants and animals. They break down these wastes into simple chemicals. This process usually releases some unpleasant smelling gases.

6 These chemicals are used by green plants to help make their food.

7 Most need clean air, clean water, and shelter. Often the actions of people deprive living things of these necessities and upset the cycles of nature. This can harm not only the plants and animals, but it can also harm people.

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Let's look at a food chain

Before reading the questions on this page, assemble the slider and wheel as described on Activity Master 3. Then use the slider and wheel to see if you can guess the answers. Cover the answer column or fold this page as you did with Activity Master 4.

Questions

1 Move the slider so the words *green plants* show in the opening. What would happen if many green plants were killed?

2 Can you think of ways that green plants might be destroyed in great numbers?

3 Now move the slider so the word *plant-eaters* shows in the notch. What might happen if great numbers of plant-eaters were destroyed?

4 Now move the slider so the word *meat-eaters* shows in the notch. What might happen if great numbers of meat-eaters were destroyed?

5 Small changes are always taking place in natural cycles like the food chain. These are usually not a problem because nature can adjust to small changes. Why then do we worry so much about the changes caused by pollution?

6 How can we decide if pollution caused by people will seriously upset a natural cycle?

Answers

1 There would be no food for plant-eaters.

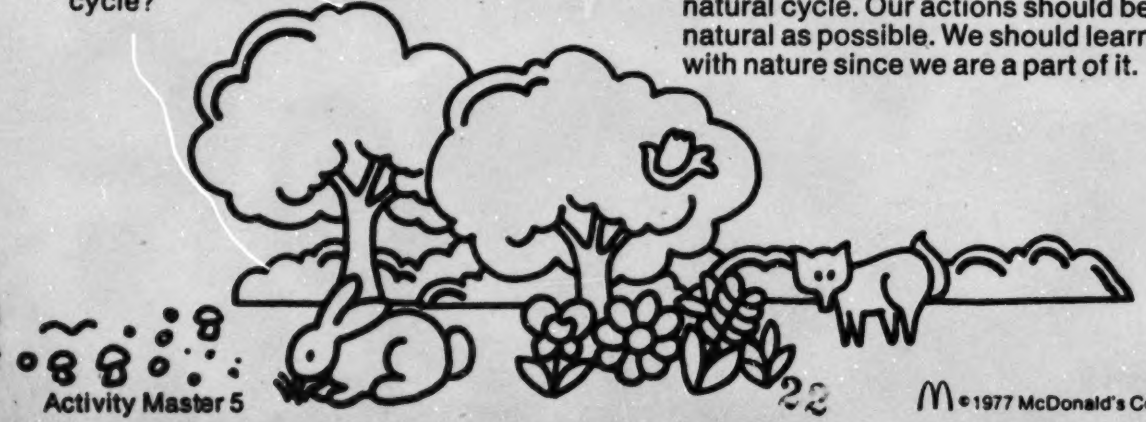
2 They can be destroyed in great numbers by such things as forest fires, by weed killers, by people when they clear land to build on it, and by certain natural diseases.

3 There would be no food for the meat-eaters. They would then either starve or have to move away.

4 If there were no meat-eaters there would, in time, be too many plant-eaters. They would then eat all the plants. As a result they would either starve or have to move away.

5 Many of the changes that pollution causes are *not small.* Pollution can destroy large numbers of plants or animals and seriously upset natural cycles.

6 Actions that affect a great number of plants or animals will seriously upset a natural cycle. Our actions should be as natural as possible. We should learn to live with nature since we are a part of it.



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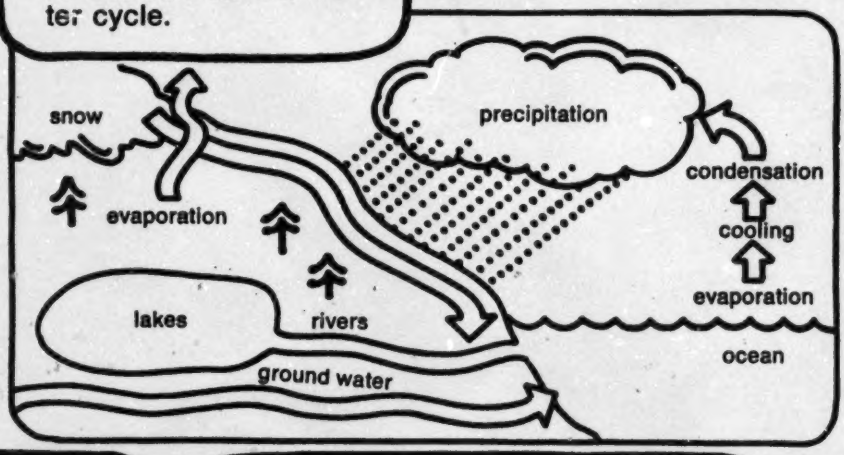
Hi! I'm DRIP the water drop

I've been on earth a long time. Years ago dinosaurs drank me . . . and you might have drunk me yesterday. Tomorrow no one will be able to drink me unless you keep me from being polluted.

In case you didn't know, this is where I usually live—in the natural water cycle.

Sometimes I'm borrowed from the natural water cycle and used by you. Do you know how I get from the cycle to your home?



Sure I come from a pipe. But before I was in the pipe I was drawn from a *river, reservoir, well, lake,* or *ocean.*

And on the way to your home I am usually cleaned at a purifying plant.

Others borrow me from the natural water cycle too. Here are some. Can you think of others?

What would they want me for? Listen to this!

It takes 150 gallons of water to make the paper for one Sunday newspaper . . .

. . . 650 gallons of water to make the steel for one bicycle . . .

. . . 75 gallons of irrigation water to grow just one ear of corn . . .

. . . and 200 gallons of water to make the rubber for one car tire.

It's nice to be needed by so many people . . . but being popular is a problem . . . for you and for me. (Go to next page.)

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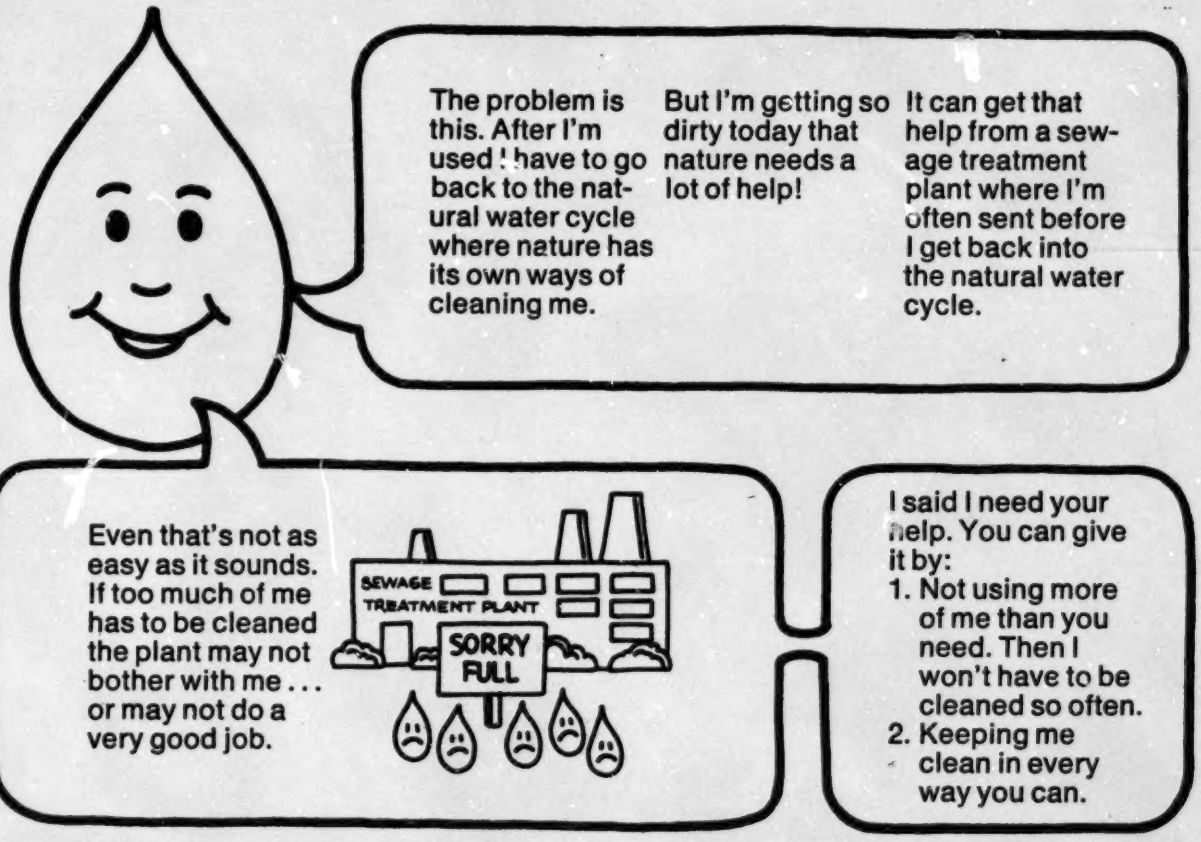
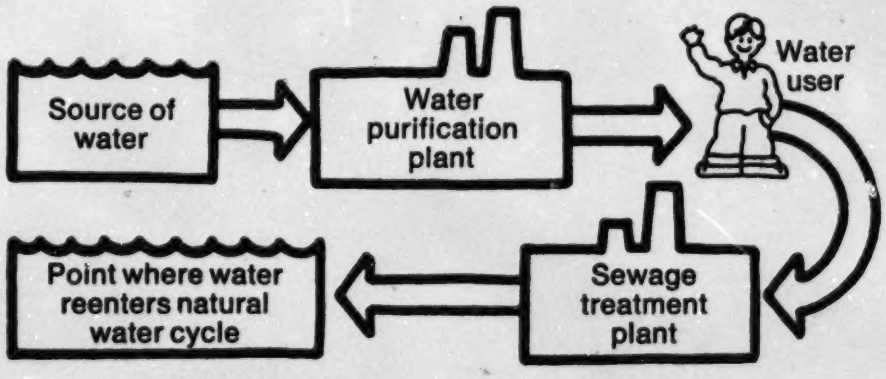

The problem is this. After I'm used I have to go back to the natural water cycle where nature has its own ways of cleaning me.
But I'm getting so dirty today that nature needs a lot of help!
It can get that help from a sewage treatment plant where I'm often sent before I get back into the natural water cycle.
Even that's not as easy as it sounds. If too much of me has to be cleaned the plant may not bother with me . . . or may not do a very good job.
SEWAGE TREATMENT PLANT
SORRY FULL
I said I need your help. You can give it by:
1. Not using more of me than you need. Then I won't have to be cleaned so often.
2. Keeping me clean in every way you can.

Where does your water come from... Where does it go?

Study the diagram below. Then see if you can answer the questions that follow it.



1. Do you know the source of the water you use at home?
2. Is your water purified *before* you use it? *After* you use it?
   Do you know where this purification takes place?
   Do you know where the water you use reenters the natural water cycle?

Can you find out...

. . . how nature purifies water?
. . . how water is used in making steel? In making paper?

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There is little danger of North America running out of water. But there is a danger that we will run short of *pure* water.

You can help prevent this by using only as much water as you need. If you study how you use water now, you will be able to find ways to use less.

Activity 1 Water you use yourself

Study the two charts below. Then keep this sheet with you for a day. Mark it each time you use water. You can use the back of this paper to do your figuring.

Remember this is an estimate, not an exact measure of how much water you use. Therefore you can use the *average* amount given in the second column when you do your figuring. For example if you get six drinks of water a day, you would estimate 6 x ¼ = 1½ gallons. (Note: the averages assume you let the water run to get hot or cold. You wouldn't, for example, drink ¼ gallon of water each time you get a drink, but that much would run from the faucet if you let it run to get cold.)

how you use it	average amount for one use	put x below for each use	total
taking a bath	30 gallons		
taking a shower	20 gallons		
flushing a toilet	3 gallons		
washing hands or face	2 gallons		
getting a drink	¼ gallon		
brushing teeth	¼ gallon		
other	you estimate		

Your share of your family's water

Some water is used for the good of everyone in your family, such as water for cooking and cleaning. This chart can help you estimate your share of that water. Suppose, for example, that there are five people in your family. If you estimate that water for meals, cleaning and other family uses equals 100 gallons, your share is 100 ÷ 5 = 20 gallons.

how you use it	average amount for one use	put an x for each use	total
washing dishes for one meal	8 gallons		
cooking a meal	5 gallons		
using automatic clothes washer	32 gallons		
other:	you estimate		

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Activity 2

Shower vs. bath

Do you use more water taking a shower or a bath? Here's how you can find out.

1. When you next take a bath, use a piece of adhesive tape to mark the height of the water in the tub.
2. Let the tape remain in the tub. Then the next time you bathe, take a shower. Be sure to put a stopper in the tub.
3. When you are finished with your shower, use the tape to check the height of the water in the tub. Did you use more or less water than the time before?

Activity 3

More or less

Finish the following sentences with your own ideas.

1. I can save water when I brush my teeth by _____

_____

2. I can save water when I sprinkle a lawn by _____

_____

3. I can save water when I wash dishes by _____

_____

4. I can save water when I get a drink of water by _____

_____

Activity 4

Can you solve this?

A family of four persons uses about 280 gallons of water a day. Suppose that this family could save 12 gallons of water each day. If everyone in the United States did the same, how much water could be saved each day? (Assume that there are 200,000,000 people in the United States. And be sure to read the question carefully. It could trick you!)

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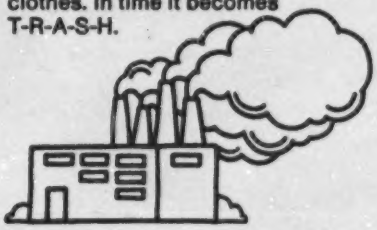
A very short history of trash

1 People have always had trash. Only Cavedwellers didn't have a big problem with it. In those days, there was plenty of room for trash. And nature easily disposed of it.

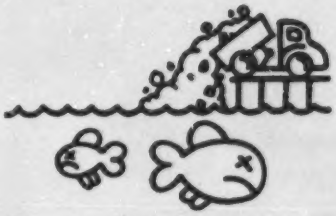
2 Today, trash is a *big* problem. More people mean more trash and more different kinds of trash. You name it—cans, paper, bottles, garbage, old cars, old clothes. In time it becomes T-R-A-S-H.

3 Every year, each one of us throws away almost ONE TON of trash. If you piled this trash in your living room, it would come to your shoulders.

4 In one year, all our trash amounts to 360,000,000 tons. We have problems with trash that Cavedwellers never had. To get rid of it, we have tried to . . .



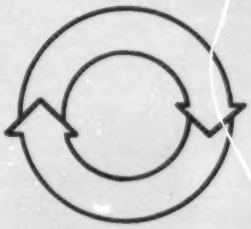
5 . . . burn it. But burning trash can cause air pollution.



6 . . . dump it in the ocean. But dumping can pollute the ocean, too.

7 . . . bury it. But we're running out of empty land near cities.

8 Some scientists have even suggested shooting it off into empty space. But who wants old tennis shoes and pop cans orbiting the earth?



9 In the past few years, however, we have found a new way to get rid of some of our trash. It's called RECYCLING.

Recycling means reusing our trash instead of getting rid of it. This solves the problem of what to do with our trash and it also helps us with another problem. By using the same materials over and over again, we save our natural resources.

Recycling means shredding old cans and cars and melting the pieces to make new metal for new cans and cars . . .

. . . chopping up grass cuttings and garbage to burn for energy or to make fertilizer to help new plants grow . . .

. . . crushing bottles into tiny glass bits and melting these bits to make new glass.

You may have taken part in a paper drive. To see how paper is recycled after it is collected, put together the picture puzzle on the next page.

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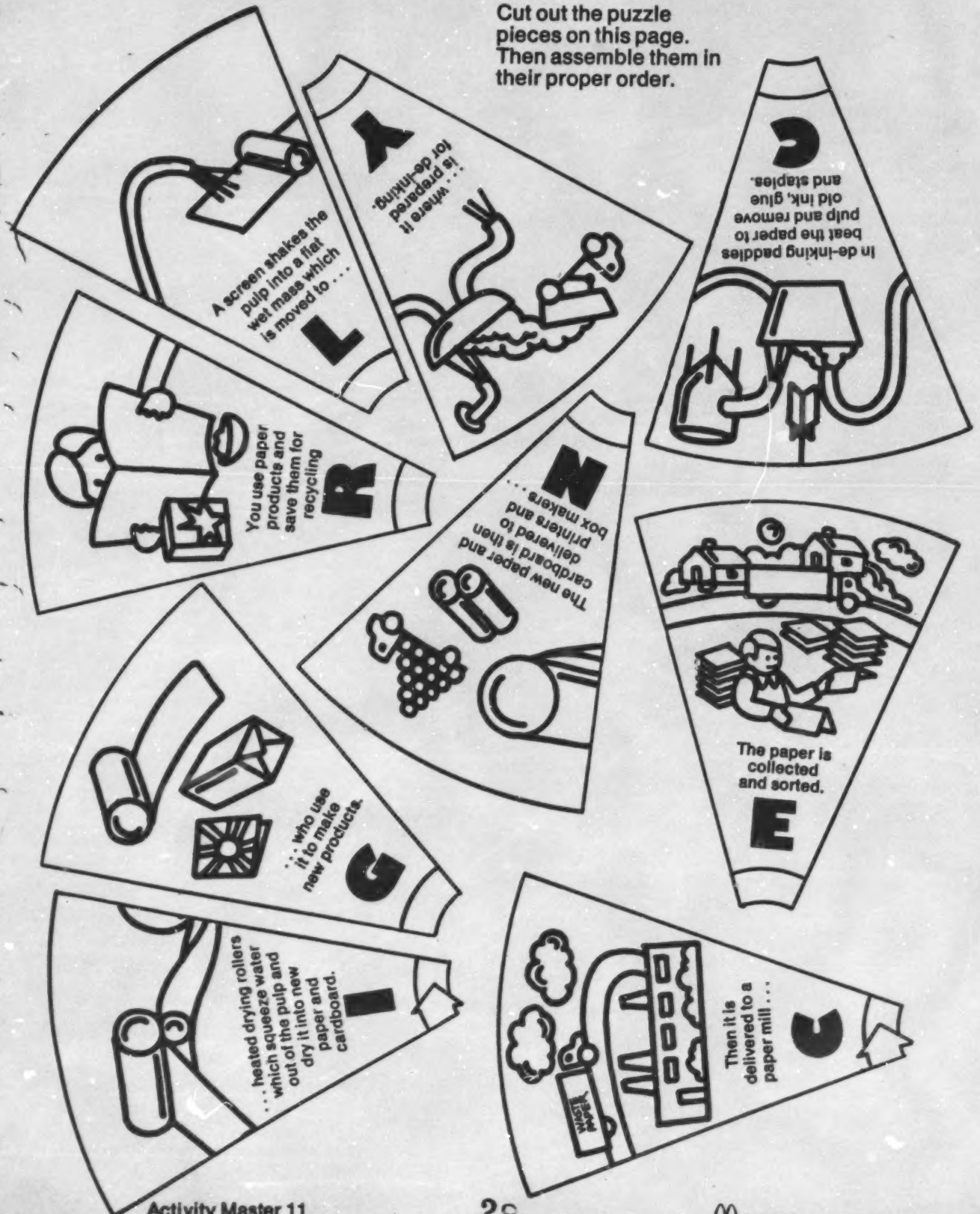
How paper is recycled

Cut out the puzzle pieces on this page. Then assemble them in their proper order.


A screen shakes the pulp into a flat wet mass which is moved to . . .
L
. . . where it is prepared for de-inking.
Y
In de-inking paddles beat the paper to pulp and remove old ink, glue and staples.
C
You use paper products and save them for recycling
R
The new paper and cardboard is then delivered to printers and box makers . . .
N
The paper is collected and sorted.
E
. . . who use it to make new products.
G
. . . heated drying rollers which squeeze water out of the pulp and dry it into new paper and cardboard.
I
Then it is delivered to a paper mill . . .
C

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Be an ecology champion

How many ecology badges can you wear?

How many of these ecology projects can you do around your house? Color the badges that apply to you. Paste them on light cardboard and cut them out. Reverse a piece of tape so you can stick the sticky side to the back of a badge and then to your chest.

Now Make Your Own Badges

What other ecology projects can you do around your home or neighborhood? Use one of the badges above for a pattern and make your own badges. Think of one for as many ecology projects as you can.

Activity Master 12

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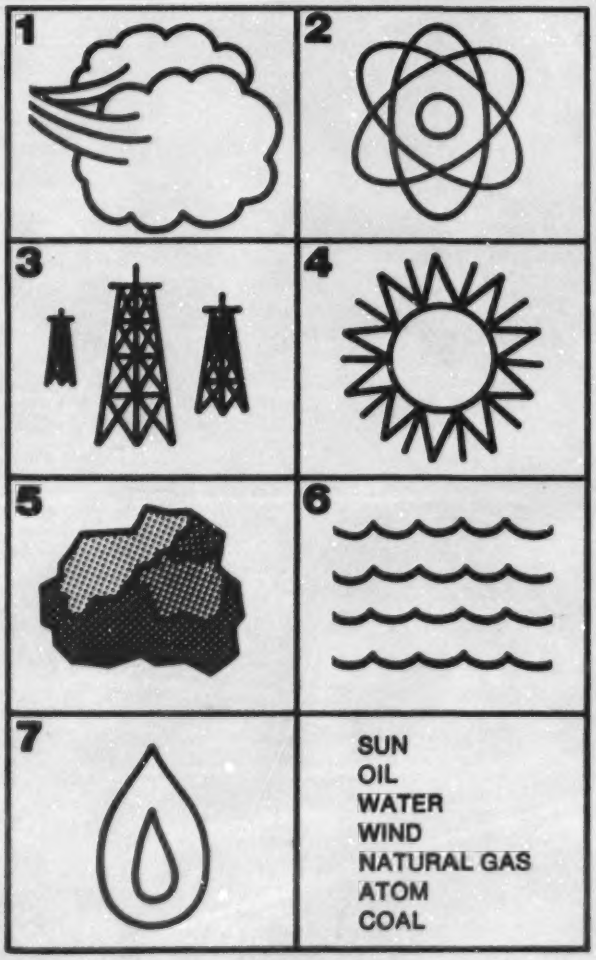
I'm Buzzy the Energy Bee!

I'm always busy, so people say I have lots of energy. I've been picked to tell you about a different kind of energy—the energy people use to heat their homes, run their cars, and turn their machines.

Our world is full of energy. Each picture below shows a thing that makes energy. Under the pictures are some names. Can you match the pictures and the names? To help you get started I'll give the answer to one—#7 is natural gas.

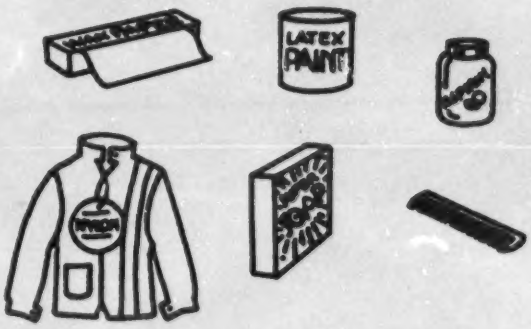


SUN
OIL
WATER
WIND
NATURAL GAS
ATOM
COAL

The energy sources people use the most are called fossil fuels. These fossil fuels are oil, coal, and natural gas. They are found underground. People sometimes dig tunnels to reach the coal. They drill wells to find oil and natural gas.

These fossil fuels are burned to make energy in the form of heat. Then some of the heat is used in making electricity for lighting our homes and running appliances like refrigerators. Much of the oil is made into gasoline for cars and trucks.

Oil is also used to make many things we use. I drew some of them here. Draw a circle around the ones you have in your home.



We have some problems

A problem with oil, coal, and natural gas is that there is only so much of it in the earth, and someday hundreds of years from now, it will be used up. Because of this, scientists are looking for a kind of energy that cannot be used up.

Another problem with oil and coal is that they are sometimes dirty when they burn. People who drill for oil and dig for coal are looking for ways to make them clean. Scientists are also trying to find new kinds of energy that will be clean when used.

Look again at the pictures of things that make energy. Can you find three that will not be used up?

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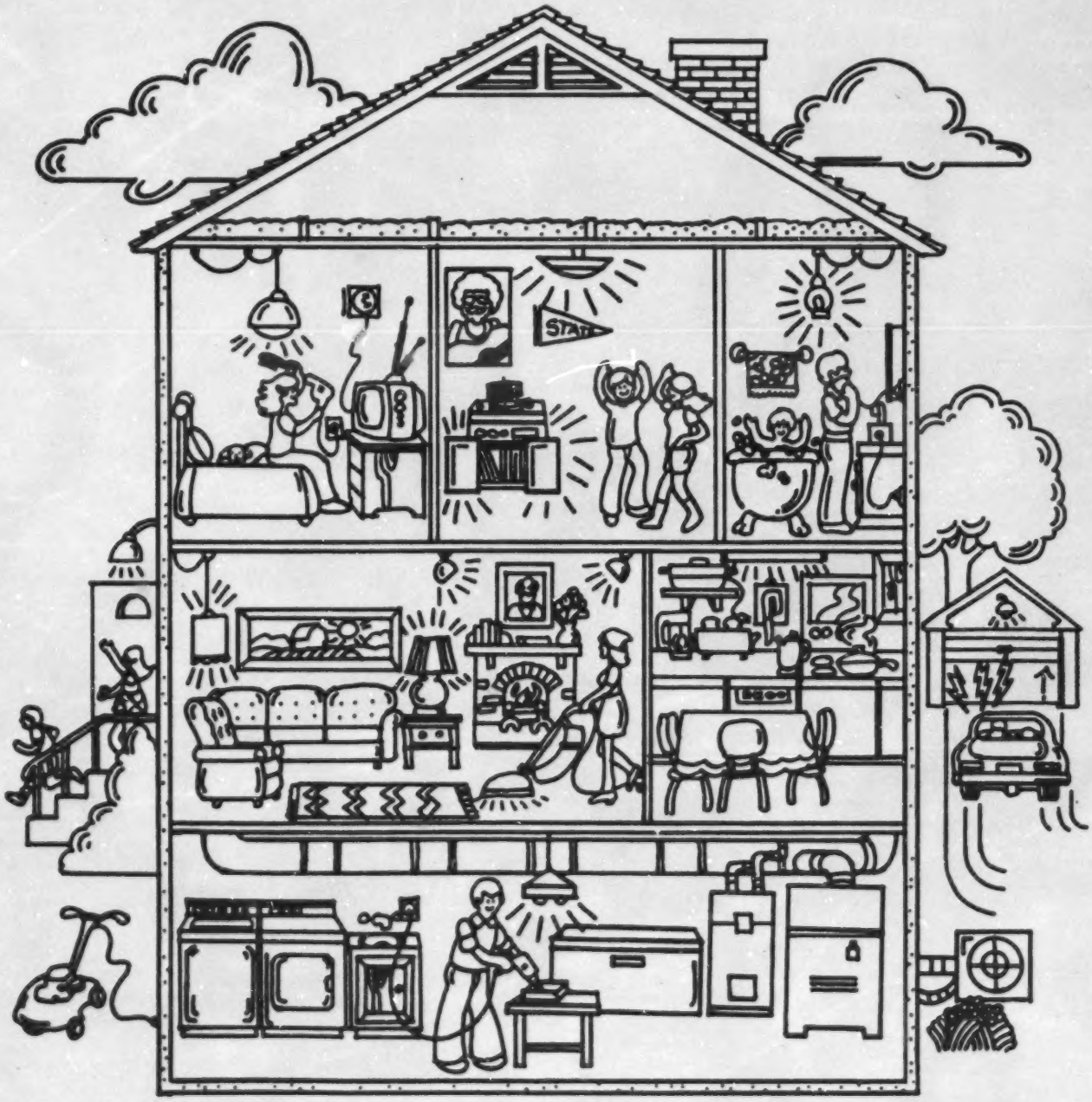
Energy home

Stores, factories, cars, offices, schools, trucks and planes use most of the energy in our country. But a lot of energy is also used in our homes. And that is the one place that all of us can help to save energy. Here is an Energy Home. How many things can you find that use energy? Make an X with a red crayon on the things that you think use more energy than others. Use a blue crayon to draw a line under places that *you* can save energy. Use a green crayon to draw a line under the places that *your family* can save energy.



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Buzzy's easy energy slider-1

This is what I call my Easy Energy Slider. To put it together just follow the directions. Then use the slider with friends family.

1 Cut on the solid lines.

2 Then make a fold at line A.

3 Next make a fold at line B.

4 Paste the section marked to the back of the area marked C.

5 An important part of your slider is now complete. Go on to Activity Master 16 for the questions and answers to use with your Easy Energy Slider.

Amaze your friends!

Teach your brothers and sisters!

Surprise your parents!

Ask them these questions.

CUT OUT

(answers on other side)

LINE B

C

Buzzy Bee's easy energy slider

Were these your answers?

CUT OUT

(questions on other side)

LINE A

RATE YOURSELF

19-24 right:
You know it—now do it!

13-18 right:
Good try—but try again.

7-12 right:
Better be more energetic.

1-6 right:
Study this energy slider or you may become an energy drone.

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Activity Master 15

1 Instructions: Cut along the solid line.

2 Fold along line A.

3 Insert the folded paper carefully into the Easy Energy Slider you made with Activity Master 15.

4 Be sure the questions show through the opening marked "QUESTIONS."

5 Quiz your friends, your brothers and sisters, and your parents. See how well they do.

Buzzy's easy energy slider-2

QUESTIONS

1. What are the two biggest uses of crude oil?
2. What kind of energy starts a car?
3. What do people build when they want energy from falling water?
4. Is natural gas used in your car?
5. Can you name two fossil fuels?
6. What is the name for oil when it comes from the ground?
7. What must you do to release the energy of a fossil fuel?
8. Which will we run out of first, solar energy or fossil fuel?
9. What are three ways to save energy in heating a house?
10. What would you do to keep heat inside a cooking pot?
11. What fossil fuel do we have the most of?
12. What can be done to coal to make it a more desirable fuel?
13. What can you do to a television set to save energy?
14. What can you do to help your family save gasoline?
15. What makes wind an undependable energy source?
16. A pound of what fuel does as much work as 4 million pounds of coal?
17. How could people who live away from bus lines save gas going to and from work?
18. How could people save energy on vacation trips?
19. What are some schools doing to save energy?
20. What traffic law was passed to help save gasoline?
21. What type cars do people in Europe often drive to save gasoline?
22. What kind of transportation uses more than half of all gasoline?
23. Who is one of the most important people when it comes to saving energy?

LINE A

ANSWERS

1. For gasoline and heating oil.
2. The electrical energy stored in the battery.
3. Dams.
4. No. Natural gas is not the same as gasoline.
5. Only two? There are three: oil, coal, and natural gas.
6. Crude oil.
7. Burn it.
8. Fossil fuel.
9. Turn down the thermostat, put in storm windows, insulate the walls and ceiling.
10. Put a lid on it.
11. Coal—maybe 600 years' worth.
12. Clean it by turning it into natural gas.
13. Turn it off when no one is watching it.
14. Ride your bike, take a bus, or walk.
15. It doesn't blow all of the time.
16. Uranium, one of the fuels used in nuclear reactors.
17. They could organize car pools.
18. They could take shorter trips or use trains and buses.
19. Turning down their thermostats.
20. The speed limit on highways was cut to 55 MPH.
21. Small, light-weight cars.
22. The family car.
23. You are!

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continued from page 12

The questions concern energy facts and energy conservation methods, thus emphasizing the dual thrust of this entire program: information and appropriate action based on that information.

Additional activities:

1) Hold an energy fair. As a class or school project have students prepare science and art projects showing many different things about energy—where it comes from, how it is used, how it can be saved. Projects might include samples and descriptions showing how energy sources of the future such as geothermal or solar power might work.

2) Invite a speaker from your local power company. Ask the speaker to tell students about the energy sources the company now uses and the company's plans for the future.

3) Have a Let's-Start-Right-Here discussion. Ask students to suggest as many ways that they can think of to conserve energy at school, at home, and in their neighborhood. For an art class have students make posters recommending some of these energy-saving suggestions.

Bibliography

The following is a list of outstanding books, filmstrips and 16mm films which correlate with the topics of the *Ecology and Energy Action Pack.*

Practical action guide

THE DO-IT-YOURSELF ENVIRONMENTAL HANDBOOK. Prepared by the Dayton Museum of Natural History. Published by Little Brown and Company, 1972.

This extremely practical handbook provides sensible guidance and action checklists for practicing conservation and environmental concern at home, in school, and in your community. This is a highly recommended resource for teachers.

Books for students

Bendick, Jeanne *ECOLOGY.* Watts, 1975.

A simple and very interesting introduction to the chain of life and other aspects of ecology, with suggestions for experiments.

Miles, Betty *SAVE THE EARTH! AN ECOLOGY HANDBOOK FOR KIDS.* Alfred A. Knopf, 1974.

The problems of land, air and water pollution are explored through text, poems, drawings, and photographs. The book suggests many do-it-yourself projects.

Pringle, Laurence *CITY AND SUBURB: EXPLORING AN ECOSYSTEM.* Macmillan, 1975.

This unique introduction to the ecology of metropolitan areas will help your students understand the places where most of us spend our lives.

Jennings, Gary *THE EARTH BOOK.* Lippincott, 1974.

This book, illustrated with beautiful photographs, examines the many kinds of pollution to which people are subjecting the earth and outlines steps students can take to deal with the problem.

Adler, Irving *THE ENVIRONMENT.* John Day, 1976.

This very readable, well-illustrated book tells what the environment is, how we have damaged it, why conservation and recycling are so important.

Smith, Norman F. *SUN POWER.* Coward, 1976.

An excellent text with charming illustrations tells how everything that lives and grows on earth uses energy from the sun and how solar power may be used in the future.

Filmstrips

COMMUNITIES OF LIVING THINGS. McGraw-Hill. Silent, color.

A series of six filmstrips explains in simple terms the interdependence of animals and plants on each other and on their environment.

THE POLLUTED PLANET. Society for Visual Education. Sound, color, 80 frames, 13 minutes.

This presentation reminds students of our dependence on the earth's natural resources and stresses the necessity of personal commitments to clean up our planet.

URBAN ECOLOGY: SIX MICROSYSTEMS. Eyegate. Silent, color.

Series titles: *Paved School Yard, Vacant Lot, Pocket Park, Park Pond, Grass School Yard, Construction Site.* Designed to introduce the concept that ecology can be studied in the city as well as in the country.

Films

MEECOLOGY. Color, 26 minutes. Modern Talking Pictures.

This excellent film portrays children from rural, urban, suburban and inner city surroundings relating to their environments in ecologically productive ways. The children in the film, produced to be used with this booklet, elicit audience participation with riddles and thought-provoking questions.

HOW TO STUDY ECOLOGY: A FIRST FILM. Color, 10 min., BFA Educational media.

This film introduces the student to the study of ecology and suggests ways that a beginning ecologist can initiate a study of a small area in which he or she is interested.

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